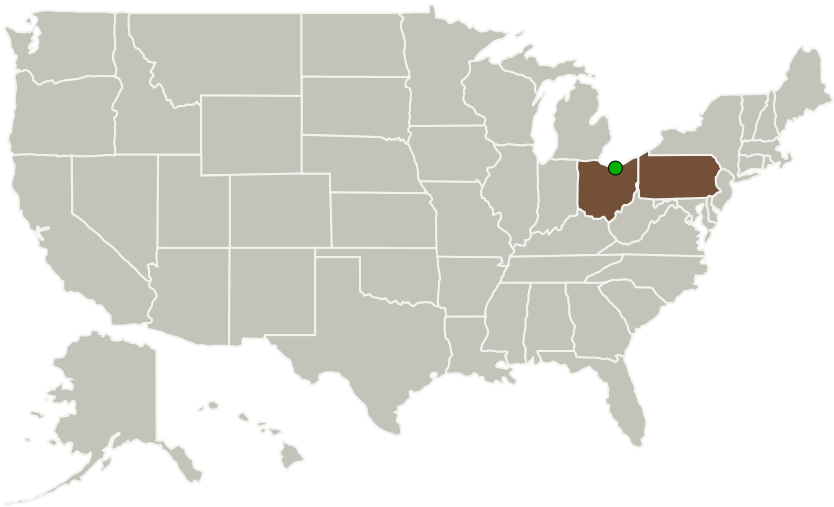
Improved Foreign Object Damage Performance for 2D Woven Ceramic Matrix Composites, Phase I

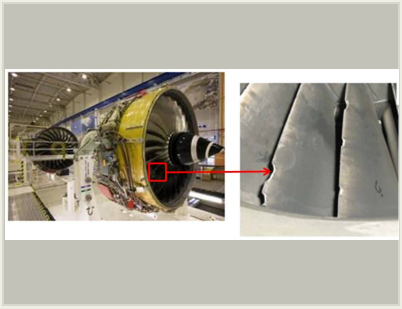
Completed Technology Project (2013 - 2014)

Project Introduction

As the power density of advanced engines increases, the need for new materials that are capable of higher operating temperatures, such as ceramic matrix composites (CMCs), is critical for turbine hot-section static and rotating components. Such advanced materials have demonstrated the promise to significantly increase the engine operating temperature relative to conventional super alloy metallic blades. They also show the potential to enable longer life, reduced emissions, growth margin, reduced weight and increased performance relative to super alloy blade materials. MR&D is proposing to perform a combined analytical, fabrication and experimental program to achieve the program objectives of developing innovative approaches to improving foreign object damage (FOD) resistance of CMC materials, specifically with Hyper-Therm High Temperature Ceramics's material system as this will be used by Rolls Royce for turbine engine hot-section components. MR&D will develop finite element math models of the CMC material specimens and the high velocity metal projectiles to simulate impact testing. The models will first be verified by reproducing experimental data measured on impacted baseline CMC specimens. Thereafter, candidate methods for potential improvement of the FOD resistance will be analytically investigated through mathematical simulations of impact tests.

Primary U.S. Work Locations and Key Partners





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Organizations Performing Work	Role	Type	Location
Materials Research and Design, Inc.	Lead Organization	Industry	Wayne, Pennsylvania
Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio
University of Dayton Research Institute	Supporting Organization	Academia	Dayton, Ohio

Primary U.S. Work Locations	
Ohio	Pennsylvania

Project Transitions

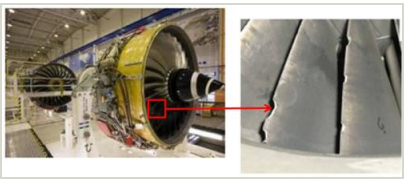
May 2013: Project Start

May 2014: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/140718)*

Images



Project Image
Improved Foreign Object Damage Performance for 2D Woven Ceramic Matrix Composites
(https://techport.nasa.gov/image/128771)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Materials Research and Design, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

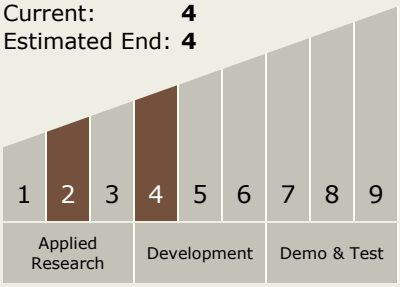
Carlos Torrez

Principal Investigator:

Edward J Klock-mccook

Technology Maturity (TRL)

Start: **2**
Current: **4**
Estimated End: **4**



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Completed Technology Project (2013 - 2014)

Technology Areas

Primary:

- TX13 Ground, Test, and Surface Systems
  - TX13.1 Infrastructure Optimization
    - TX13.1.7 Impact/Damage/Radiation Resistant Systems

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System